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The effect of video printer technology on event memory in young children.

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THE EFFECT OF VIDEO PRINTER TECHNOLOGY ON EVENT MEMORY IN YOUNG CHILDREN

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by

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ABSTRACT

THE EFFECT OF VIDEO PRINTER IN EVENT MEMORY
IN YOUNG CHILDREN

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This study explored the effect of a video printer on young children's ability to analyze and remember an event. It was hypothesized that five-year-old children could remember episodic events if they reflected on episodic events through the use of a video printer. In order to investigate this hypothesis 24 children aged five and seven years were asked to make six pictures from a video tape of an episodic event by using a video printer. Another 24 children, aged five and seven years, just saw the video tape. Children in the video printer group sequenced the video prints and told a story about those pictures while looking at the pictures. Immediately after the pictures were removed and again they were asked to tell the experimenter about the event. One day later they were again asked to retell the story of the event and then to sequence the video prints. The children who only saw the videotape went through the same procedures as those in the video printer group, but they were given pictures made by children in the video printer group.

A 2 (age) by 2(treatment condition) by 3 (free recalls) ANOVA was performed for the three free recall measures: immediate recall with pictures, immediate recall without pictures,

and delayed recall without pictures. A 2 (age) by 2 (treatment) by 2 (sequencing) ANOVA was performed for 2 sequencing measures: immediate picture sequencing test and delayed picture sequencing test. For free recalls the two-way interaction between age and treatment condition was significant with the five-year-old children performing better in the video printer group than five-year-old children in the video only group. These same results held for the picture sequencing tasks.

The children's words in describing each segment of the event were scored according to accuracy. Each video print was scored according to its status as a readable breakpoint in the event. These data, along with the free recall and picture sequencing data yielded the conclusion that children who can make their own video prints engage in more meaningful processing of the event. This depth of processing aided memory.

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CHAPTER 1

INTRODUCTION AND REVIEW OF LITERATURE

Introduction

It is well known that video technology is useful for learning at school. Its usefulness is well accepted for teacher education, the therapy of hyper-active children, and lesson instruction. Technological development has brought us complicated video technology such as video CDs and video printers. To take full advantage of living in a modern society, we must explore how this new technology can be applied to learning at school. Studies of media have tried to explore the impact of technology on learning. These studies have stressed the idea that media can contribute to improvements in learning by researching such approaches to learning as other-controlled vs self-control. Few studies have attempted to investigate a psychological mechanism for learning that can be enhanced by the use of media.

Following Salomon's (1979) theory of filmic supplantation of the mental process, psychologists used media extensively for therapeutic purpose. They used "reflection principle" to adapt video material for behavior correction. The term “reflection” seems to be ambiguous in terms of psychological mechanisms. Many psychological phenomona might be termed "reflection". In the presesent study, I tried o trigger psychological mechanisms by which children might process sequential information when they use video printer technology.

Recently, many developmental theories have faced criticism. Much criticisms is aimed at studies using context-independent and complex tasks (Gellman & Baillargeon, 1983). Many studies have shown that young children have greater ability to remember, infer, and solve problems than previously believed if they are given appropriate tasks (Gellman & Baillargeon, 1983; Karmiloff-Smith, 1992). In the literature on memory development, younger children were not believed to have the same processing capacity or ability to use mnemonic strategy as older children (Siegler, 1991). Mnemonic strategies were found to contribute to developmental differences in memory(Bjourklund, Ornstein, & Haig, 1977). Younger children were not found to use these strategies whereas older children used them (Borkowski, Carr, & Pressley, 1987). If younger children are appropriately induced to use these strategies, they might reveal their competence. In present study, the possibility of spontaneous use of mnemonic strategy and its subsequent effects on memory in young children was explored with video printer technology.

Video printer technology seems to have educational value for young children. The video printer is a machine with which children can make photographs of images from video tapes. When children make pictures of their own experiences, they may reflect upon those experience. This reflection would help children remember the event that they experienced. Therefore, young children might improve their memory if they reflected on the event they experienced by using the video printer. In this study, the effects of video printer on event memory in young children will be explored.

Review of Literature

Development of Event Knowledge

Event Knowledge in Young Children

With repeated experience of a routine event, people come to have schematic representations about the event. When a person faces a similar event, he or she has a set of expectations about that event (Schank & Abelson, 1977). This set of expectations is called "a script" (Abelson, 1981). The script model was developed by Schank and Abelson (1977). According to their script model, a script consists of slots to be filled with an ordered sequence of actions organized around a goal, actors, and props (or objects) within a particular spatial-temporal context (Nelson, 1986). For example, in a restaurant menu script (Schank & Abelson, 1977), the sequence of actions consists of entering a restaurant and then asking for the menu before ordering food. The actors are the customer and the waitress or waiter. With repeated experience of similar events, a restaurant script is formed and this general knowledge of restaurant events guides attention, retention, and retrieval whenever a new restaurant event is experienced (Mandler, 1983, 1984; Minsky, 1975). As a schema-memory model, the script model has been found to have its theoretical validity in literature concerning adult memory (Abbott, Black, & Smith, 1985; Linton, 1975, 1982; Reisser, 1986; Reisser, Black, & Abelson, 1985).

However, the evidence relating to script formation in young children is contradictory. It was found that the younger the children were, the more they depended on general event knowledge or scripts to remember a novel event. Four-year-old children recall familiar story episodes very well whereas older children recall them regardless of their familiarity (Mandler, 1983; Slackman & Nelson, 1984). Three-year-old children depend more on scripts to remember similar events than older children do (Hudson & Nelson, 1986). Farrar and Goodman (1990) found that four-year-old children could not remember an episodic event after their first experience of it, but remembered the event better with experience even though they omitted many of the details of the event. Seven-year-old children, however, remembered details of the event even after their first experience. These findings suggest that younger children rely on schematic structure in memory because they automatically use general knowledge structures to organize the events but attend less well to deviations from general knowledge (Hudson, 1986; Hudson & Nelson, 1983).

Contrary to these findings, Hudson (1990) found no developmental differences between four- and five-year-old children who depended on a script to remember the creative movements of an episodic event. Five-year-old children in his study did not depend on general knowledge the way seven-year-old children did to remember a distinctive episodic event (Hudson, 1986).

Developmental differences in event memory have also been shown, depending on the nature of the event. Even four- and five-year-old children can remember events in sequence such as birthday parties, getting dressed, eating lunch, or playing at school (Fivush 1984; Fivush & Nelson, 1982; Fivush & Slackman, 1986; Hudson & Nelson, 1983; Hudson & Nelson; 1986; Nelson, 1986). One study found that four-year-old children remembered a restaurant event in sequence better than five-year-old children. Five-year-old children remembered getting dressed in sequence better than four-year-old children (Nelson & Gruendel, 1986). Seven-year-old children can consistently recall an arbitrary event such as a birthday party (Fivush, 1981; Nelson, 1979) but preschoolers and first-grade children do not remember an arbitrary event very well (Hudson & Nelson, 1983). Even with experience, four- and five-year-old children can not remember an arbitrary event (Fivush, Kuebli, & Clubb, 1992).

In general, there seem to be some developmental differences in event memory, depending on the familiarity and nature of the event.

Script and Picture Sequencing

Since Piaget, the results of picture sequencing tests in children have had two important implications for children's cognition. Piaget (1946) and his colleagues explored children's mental operations by asking children to sequence pictures. Children were shown two to five pictures in scrambled order and asked to sequence the pictures and tell a story about them. Results of his study indicated that children could not reconstruct the pictures and tell a story. Piaget and his colleagues then concluded that children lack the ability to infer logical relationship-causality among the pictures.

This conclusion was challenged by several researchers who simplified the picture sequencing task. In Brown's and French's (1976) study, four- and five-year-old children were presented with sequenced pictures in which the final picture was omitted and then asked to identify the missing final picture from several other pictures. Young children could infer and identify the missing final picture. Others have found similar results (Schmidt & Paris, 1978), but this research has been criticized because of the simplicity of the task.

Other researchers used script-based pictures to explore children's ability to sequence a real event. A script is a knowledge scheme that consists of the temporal sequences of familiar events. Researchers, who used script-based pictures, assumed that if children have knowledge of the content of pictures, they can infer correct relationships among the pictures. Most researchers chose pictures on the basis of an existing script which children already had. In general, it was found that young children could sequence pictures of familiar events. Five- and six-year-old children could sequence pictures in forward order if they involved familiar events such as "going to McDonalds" or "going to the super-market", but four-year-old children failed to sequence pictures of familiar events (Catellani, 1991; Fivush & Mandler, 1985; Fivush & Nelson, 1982). Five- and six-year-old children failed to sequence unfamiliar events in forward order and familiar events in backward order (Fivush & Mandler, ex. 1, 1985), but they could sequence pictures of an unfamiliar event when they were shown pictures in correct order and were then allowed to reconstruct those pictures (Fivush & Mandler, ex. 2, 1985).

Researchers also found that four- and five-year-old children could sequence pictures in forward order when they were told a story connecting the pictures and then reconstructed them (Brown & French, 1976; Brown & Murphy, 1975).

A picture is a mode of representation of knowledge. The ability to understand picture mode seems to develop from age five-year because they are able to sequence pictures if they have content knowledge of the pictures.

Interactive Video Technology

Gagne's Information Theory of Learning

The Information-processing theory of cognition is well recognized in the area of cognitive psychology. Typical models of information theory in children include Sternberg's (1985), Case's (1985), and Klahr's (1989). Based on information theory, Gagne (1985) posited an information-processing theory of learning. Gagne (1985) emphasized each phase of information-processing, from encoding to short term memory, and long term memory. In his model of information-processing of learning, all external events of instruction at each phase of information-processing "support" information-processing. Even though he regards each phase of information-processing as important, he thinks that the central operation is “executive control” process that affects learning and process informations in long-term memory (Gagne, 1985).

"Executive control" is defined as "conscious control" at the encoding phase of information-processing. For Gagne (1985), this executive control influences the learners' approach and the way learners engage in information of a task or learning. Thus, when learners were encouraged to encode items to be learned by schematic table or vivid imagery, their memories were better than those of learners who had not been encouraged to do so (Gagne, 1985). He also believed that learners must regulate learning on their own: a process he called "self-executive control".

Learner Control and Interactive Video Instruction

Interactive video is defined as any video program in which the sequence and selection of instructional messages are determined by the user's response to the material (Floyd, 1982). It has been shown to be useful as an instructional tool because of its interactivity. Videotape is linear and has a fixed pace whereas interactive video allows the learner to regulate self-learning of a specific instructional videotape. The positive effect of learner control has been well documented (Milheim & Azbell, 1988). Undergraduate students were found to learn better if they were allowed to go over the contents of a videotape when their answers turned out to be incorrect on the video screen (Hannafin & Colamaio, 1987). Similar results have been found in other studies (Abrams, 1986; Campanizzi, 978; Kinzie & Berdel, 1990; Laurillard, 1984, 1989). Even though learner improves his or her learning with interactive technology, the degree of control seems to affect the rates of improvement of learning, depending on how much the learner is allowed to regulate speed, order, and sequence of an instructional videotape (Hannafin & Colamaio, 1987; Milheim, 1990).

When learners control their pace of learning by controlling a computer key whenever each text page is finished, they remember the factual knowledge of a "creative camera lesson" better than if the lesson proceeds in a sequence predetermined by teacher (Milheim, 1990). Learners under complete-learner-control showed the least learning improvement (Milheim, 1990). But, learners improved their learning when they controlled the instructional information on videotape with guidance or advisement (Tennyson, 1980, 1984; Tennyson, Christensen, & Park, 1984). In a study by Arnone, Grabowski, and Rynd (1994), first- and second-grade children were given the opportunity to stop and look at or to stop and ponder a videotape whenever they needed to review the tape in a test trial. The instructional material on the videotape concerned “A Visit to the Museum.” The 14 minute videotape consisted of three segments on paintings, sculpture, and ceramics. Simple narrations on the tape explained art works such as still life, portraits, etc. After seeing the video tape, the children were given an achievement test. In the test, children were shown pictures of art works which they had been exposed to in the practice video tape and were asked to “remember everything that you know about what you see.” During the treatment trials, children were either given or not given advisement. Advisement was given by an experimenter to encourage the child to stop and think about specific content, to skip a section or not, to end, etc. Results of the study indicated that first grade children with advisements recalled information better than those without it.

The effects of interactive video technology are reported to differ, depending on the content of learning. Hannafin and Colamaio (1987) reported that undergraduate students showed successful achievement of factual content of "lifesaver" information after viewing a videotape but failed to achieve the procedural knowlege or problem-solving skill of a lifesaver. Cennamo et al. (1991) reported similar results. Undergraduate students experiencing interactive video treatments showed better recall of scientific information in a post test than those who saw a linear videotape.

To summarize, interactive video technology seems to be helpful for learning, but its effectiveness seems to depend on its content and on the degree of learner control.

Orienting Activity and Interactive Video

An orienting activity is a mediator through which new information is presented to the learner. Advance organizers, introductory statements, titles, summaries, and outlines are all forms of orienting activities (Hannafin & Hughes, 1986). Advance organizers are graphic forms that display a summary of information to be learned (Ausubel, 1960). Graphic organizers were found to provide an opportunity to orient information prior to new instruction. Questioning has also been used as an orienting activity before giving new information to the learner. Pre-questioning is reportedly useful in the learning of new information because a learner can attend selectively to the information (Reynolds & Anderson, 1982). The effects of pre-questioning on learning were found in other researches (Frase, 1968; Frase, Patrick & Schumer, 1970; Koran & Koran, 1975; Reynolds & Anderson, 1982).

The statement of the objective was also found to be effective in learning. When the information to be learned is unfamiliar, clarifying the objective is useful. The learner has preconceptions or schemas (Pichert & Anderson, 1977) about the information to be learned and learners can gain other perspectives or activate appropriate schemas by receiving a specific objective of the task at hand (Caldwell, 1980; Gagne, Wager & Rojas, 1981; Smith & Boyce, 1984).

Orienting activities are well accepted by educators as effective instructional methods in the study of instruction. One common assumption seems to underline the research on the effectiveness of orienting activities: when learners encode relevant information to be learned, their learning may be improved. As Hannafin et al. suggested, learning might be improved with these orienting activities by using video or computer.

Breakpoint and Event Representation

Newtson (1973) stipulated that people perceive the behaviour stream as units of action. According to him, actions consist of breakpoints and non-breakpoints. A breakpoint is a pinpoint or spike at which a person's body is reorganized when the person moves. The breakpoint is perceived as a unit of action.

The perception of units of the behaviour stream was found to be similar among people (Netwson, 1973). Using the button technique, Newtson and his colleagues explored how one’s perception of different units of action influences the interpretation of people's behaviour and learning. In the button technique, subjects are given a button to press whenever they think a meaningful unit of the behaviour stream appears on the videotape. Segmenting the fine units of the behaviour stream enhanced people's ability to infer personality traits and problem-solving abilities of an actor on the videotape (Newtson, 1973; Newtson & Rinder, 1979). Also, the button technique improved learning. In Koopman's and Newtson's study (1981), undergraduate students were given either fine unit, natural unit, or large unit instructions. In the fine unit instruction, subjects were asked to segment lesson videotapes into the smallest possible steps of a lesson by pressing a button. Students who segmented lesson videotapes improved their concept learning and showed more favorable evaluations for their teacher.

On the other hand, Newtson suggested that if people perceive a stream of behaviour as meaningful units, breakpoints of the event were remembered better than non-breakpoints of the event. Actions of breakpoints were described more accurately than non-breakpoint actions (Newtson & Engquist, 1976). People recognized actions of breakpoints very well (Newtson & Engquist, 1976: Ex 3). Newtson, Gown, & Patterson (1980) replicated this finding with five-year-old children (Newtson et al., 1987). In addition to action units, episodic boundaries are also remembered well. In Boltz's study (1992), adult subjects remembered episodic boundaries: "major shifts in the story's plot", better than nonepisodic boundaries and could remember subsequent actions of episodic boundaries. With goal-directed activities, 26 episodes were made into breakpoints which were marked by the insertion of commercial film at each episode boundary. Non-breakpoints consisted of boundaries of individual action. It was found that all subjects remembered episodes better than the boundaries of each action. Also, subjects could remember subsequent temporal sequences of actions from episodic boundaries. Rindner (1982) found that adults who segmented events into finer units recognized breakpoints better than non-breakpoints whereas adults who segmented larger units did not show any differences in recognition memory of breakpoints and non-breakpoints of events. In Hanson's and Hirst's study (1989), undergraduate students segmented a 7 minute videotape of an event. Each subject was then given an mmediate free-recall test. Subjects who segmented small units remembered the event better than those who segmented the event into larger units. Lassiter (1988) also found that subjects who segmented events into fine units remembered the events better than gross-unit making subjects.

Mnemonic Strategy in Young Children's Memory

Organizational Strategy in Young Chilren

When a number of words was presented to them, older children (six grade and above) organized taxonomic categories to remember the words but younger children were not believed to use the organizational strategy (Bjorklund, Ornstein, & Haig, 1977). But, training studies have indicated that young children can learn organizational strategy with explicit training (Moely, Olson, Halwes, & Flavell, 1969; Ornstein, Naus, & Stone, 1977; Ornstein et al., 1985). Even though young children could use the strategy with explicit training, they were not found to use the strategy continuously when given new test items (Bjorklund, Ornstein, & Haig, 1977; Ringel & Springer, 1980). Young children's inability to use organizational strategy has been attributed to "instructional deficiency" (Borkowski, Carr, & Pressley, 1987) or to "production deficiency" (Brown & Deloache, 1978; Moley, Olson, Halves, & Flavell, 1969).

It was suggested that under some instructional conditions in which metacognition, feedback about strategy's effectiveness, or a rationale for the use of the strategy were given, children could generalize the learned clustering strategy to new word items (Rao & Moely, 1989; Ringel & Springer, 1980). Carr and Schneider (1991) found that kindergarten-age children could keep a clustering strategy for as long as 8 weeks after they were given seven training sessions. In their study, children who were given clustering instruction and group-naming were found to recall better than those who did not receve the training. Lange and Pierce (1992) also found that children maintained the strategies for 7 days after their training if they were told about the usefulness of the strategy and praise for the use of the strategy.

Even though young children were found to use organizational strategy, a number of studies have indicated that young children did not benefit from using learned strategies and did not improve their recall of new words (Bjorklund & Harnishfeger, 1987; Black & Rollins, 1982; Carr & Schneider, 1991; Paris et al, 1982). The ineffectiveness of the strategy on recall was attributed to several elements. Bjorklund and Harnishfeger (1987) suggested that young children have such a limited capacity for storage that they can not leave space to remember and they use the strategy at the same time. Alternatively, others have argued that young children failed to retrieve at recall even though they used the strategy at the training (Black & Rollins, 1982; Emmeric & Ackerman, 1978; Morrison & Lord, 1982; Paris et al., 1982). And, Rabinowitz (1984) attributed young children's failure to benefit from using learned-organizational strategy to knowledge related to test items.

Several studies indicated the effectiveness of induced strategy. When third-grade children were given supportive context such as instruction of grouping-by-meaning (Best & Ornstein, 1986; Ornstein et al., 1988), they were found to use spontaneous-organizational strategy and to improve their recall as well as generalize the strategy to low-associated words. After third-grade children were induced to group highly associated words meaningfully, their recall was better than those who received explicit training (Best, 1993). The same findings were shown in other studywith low-associated words (Sodian et al., 1986).

Even though young children have difficulty in utilizing learned strategy to improve their recall, they seem to benefit from the use of the strategy when they are induced to use it and improved their recall.

Rehearsal Strategy in Young Children

It is well known that children do not begin to rehearse until they are five- years- old. Findings show that articulatory suppression does not influence five-year-old children's memory of words (Henry, 1991; Gathercole, Willis, and Baddeley, 1992). If children rehearse, they must be influenced by the interference of articulatory suppression. Four- and five-year-old children's inability to remember the first word of a sequence of words indicates that they do not use rehearsal for word memory (Kingsley & Hagen, 1969). Similarly, three- and five-year-old children's memory of words is not influenced by phoneme similarity of the words, indicating that young children do not use rehearsal strategy (Conrad, 1971). In addition to phoneme similarity, word length effect has also been explored to determine whether or not children use rehearsal. Children who rehearse fast recall more words than those who do not use rehearsal. And short-length-words are more easily recalled than long-length-words because long-length-words take more time to rehearse (Baddleley, Thomson & Buchanan, 1975).

The effect of word length and phoneme effect on young children is largely influenced by the presentation of mode of words. Five-year-old children did not show any memory differences for pictures of phonetically similar or dissimilar words, whereas their memories were affected by visually similar pictures (Conrad, 1971, 1972; Hayes & Schulze, 1977). Hitch and Halliday (1988: ex.1) also confirmed that five-year-old children's memories were impaired by visual similarity of pictures of words but were not influenced by phonemic similarity. Also, five-year-old children's recency memory decreased with visual retroactive interference whereas older children's recency memory was impaired by auditory-retroactive interference but not by visual-retroactive interference (Hitch & Halliday, 1988). Even though young children's dependence on visual memory was reported in several studies, even four-year-old children were found to remember short-length words more readily than long-length words when the words were auditorily presented (Hitch, et al., 1989; Hulme, et al., 1984). With training in rehearsal, word length effects seem to appear. In studies involving auditory presented words, young children were required to repeat the words after the experimenter said them (Hitch & Halliday, 1983; Hulme & Tordoff, 1989). In this context, children younger than five-years-old showed a word length effect, but this effect disappeared if the young children were not required to recite the words (Henry, 1991).

In Henry's study (1991), five- and seven-year-old children were given picture cards of nine one-syllable words and nine three- and four-syllable words. Experimenters recited a word for each picture card and then placed the picture card face down in front of the children. All children were given two tests: a spatial probe and an auditory probe. In the spatial probe test, all children were asked to name a word after the experimenter pointed to the position where a picture card of the word was placed. In the auditory probe, the experimenter named a word, then the children were asked to point to the position where a picture card of the word was placed. Five-year-old children were given three lists of picture cards, then four lists of picture cards from each one-syllable word and three-and four-syllable words. Each list consisted of one picture card of a word. Seven-year-old children's memories were significantly better than five-year-old children’s memories. Five-year-old children did not show any differences in their memory of one-, three-, and four-syllable words; but seven-year-old children showed differences. With standard, full-verbal recall requests and auditory presentations, five-year-old children showed a word-length effect. In the context of standard, full-verbal recall and auditory presentations, an experimenter showed and read two words, then asked the child to repeat the words in the same way the experimenter said them. Five-year-old children remembered short length words better than long length words. When full verbal recall was required with picture cards of words, there seemed to be contradictory findings. Five-year-old children could not match copied pictures to face-down original pictures of one- and two-syllable words after they recited the words upon presentation of those pictures, indicating that they didn't use cumulative rehearsal (Allik & Seigel, 1976).

In Hitch's and Halliday's (1988) study, there was also no indication that five-year-old children used cumulative rehearsal with picture cards even after they recited the words that went with the pictures. Other studies have found contradictory results. In the Hitch et al. (1991) study, five-and eleven-year-old children either labeled pictures or remained silent, and were then immediately given a free recall test. All younger and older children who labeled the pictures showed word length effect.

Johnston et al. (1987) also found similar results once five-year-old children were trained to rehearse covertly and cumulatively or to use overt rehearsal with pictures before recall.

Rationale and Questions of the Study

Studies of children's event knowledge have explored how children form scripts. Even four-year-old children were found to have well-established scripts of routine events such as snacktime and school and to remember the events in sequence (Nelson, 1986). Even though four- and five-year-old children can remember routine events, there are developmental differences in episodic memory. Four- and five-year-old children depend on general event knowledge to remember episodic events whereas older children can remember details of episodic events regardless of their familiarity (Farrar & Goodman, 1990; Hudson & Nelson, 1986). This finding suggests that younger children have an inability to attend to deviations from general event knowledge because they dont have strong script (Farrar & Goodman, 1990).

Developmental differences of event memory depend on the nature of the event. Five-year-old children remember causal events better than arbitrary events but seven-year-old children remember both causal and arbitrary events very well (Fivush & Slackman, 1986). These findings of developmental differences seem to support the typical view of cognitive development in the memory domain: the older children are, the better they remember.

As Chi (1981) suggested, knowledge may explain the developmental differences of event memory. Script is knowledge in which general features of similar experiences are abstracted (Schank & Abelson, 1977). As Farrar and Goodman (1990) indicated, younger children might have weaker scripts because they don't have as much experience as older children. And causal events represent stronger scripts than arbitrary events because children would access semantic knowledge of the logical relationships of causal events. Therefore, both knowledge of the script and causality contribute to event memory. But there may be other factors that contribute to event memory. Recent literature on memory development in young children suggests that strategies as well as knowledge are important elements contributing to developmental differences in children's memory. Traditionally, four- and five-years-old children were not believed to use memory strategies such as rehearsal and organization whereas it was accepted that older children used advanced strategies when they remembered words and digits (Moely, 1977). But, young children can use organizational strategy with explicit instruction (Moley et al., 1969; Ornstein et al.,1985) and generalize the strategy with a provision of a rationale for using the strategy (Rao & Moley; 1989; Ringel & Springer, 1980). Even though some researchers found that explicit training of strategy helped four- and five-year-old children to utilize the strategy, they could not benefit from the use of the strategy for their recall (Emmerich & Ackerman, 1978; Garrison, 1980; Lange & Pierce, 1992). Age differences of recall hardly decreased. when younger children were instructed to use the strategy used by older children (Ornstein, Naus, & Stone, 1977; Ornstein et al., 1985).

But, young children benefited from the use of this strategy and improved their recall when they were induced to use it. Four- and five-year-old children benefitted from implicit training in memory knowledge (Rao & Moely, 1989), from implicit instruction for the use of strategy (Sodian, Schneider, & Perlmuter, 1986; Schneider & Sodian, 1991), and from the combination of spontaneous organization strategy and labeling of each word (Miller, Barron, & Probert, 1994). The effect of the spontaneous use of strategy for recall may come from "self-regulation" .

Strategy is defined as "cognitive or behavioral activities that are under the deliberate control of a child and are employed so as to enhance memory performance" (Naus & Ornstein, 1983). Explicit training in strategy might not lead children to conscious use of strategies such as organization and rehearsal and children might use the strategies passively. Theoretically, Gagne (1985) has stipulated a positive effect of executive or deliberate control on memory. Gagne suggested that "executive" (or conscious)self-control at the encoding phase of the learning processes was most important and effective for remembering. Even though spontaneous use of mnemonic strategy seems to have positive effects on children's memories, it raises many questions. One of them is how we can induce the children to use spontaneous strategies for memory. It seems reasonable that when children experience an event, they may not be consciously aware of that event, especially when they are younger. As a result, mindless experiences of events might contribute to their inability to remember an event they experience.

My assumption is that if younger children are given an opportunity to reflect on an event they experience spontaneously, they might experience that event more mindfully. Newtson and his colleagues (1976, 1987) have explored adults' perception of an ongoing event when they use the button technique. They found that adults segmented ongoing behaviour into common units. From these findings, Newtson concluded that there are event structures that lead to a person's perceptions of events. Although Newtson used a button technique to explore people's perceptions of events, his later studies used the technique to investigate its effectiveness on instruction and memory. When the button technique was used, adults were better able to remember the actions of breakpoints they segmented (Hanson & Hirst, 1989). Actions of perceived boundaries in units were also found to be remembered better. When an event was finely segmented, details of the events were well remembered (Hanson & Hirst, 1989; Newtson & Engquest, 1976). Thus, "the button technique" seems to be a good tool to encode information in depth at the encoding phase. I assumed that use of this button technique may induce children to encode events in depth. To segment events into meaningful units, children must decide how to divide ongoing behaviours of an event into units. During the process of decision-making, children must think about how each action of an event is related to the plan schemes leading to the main goal of the event. As a result, they may consciously reflect on the event.

Therefore, I assumed that this decision making process would induce children to process information in depth.

In this study, six plan schemes leading to one main goal were used to assess children's organization of an event. Children had to abstract ongoing actions into six plans of actions in order to understand each procedure leading to a main goal. In order to know how young children organize an event, I instructed five- and seven-year-old children on how to segment a videotape of an event into six units leading to a goal of an event: “How to Make Navaho Sand Pattern". Unlike Newtson's method, children were asked to make six pictures, using a video printer to infer six main actions in six plan schemes leading to a goal. Accordingly, instruction was used to "make six pictures to tell six steps of how to make a Navaho sand pattern." I assumed that when children inferred six sub-main actions and made pictures to tell the story, they would use a mnemonic strategy. This memory strategy would lead children who did not use spontaneous mnemonic strategy to improve their recall of the event.

Therefore, I hypothesized that children who segmented the event on videotape and made pictures from the videotape would remember the event better than those who did not, and that there would be developmental differences in the use of organizational strategy between seven- and five-year-old children who segmented an event intounits. If older children use better organizational strategy, their recall would be better than younger children. And, if older children use spontaneous mnemonic strategy, this strategy may not influence their memory.

As indicated in the literature, if breakpoints or perceptual boundaries of actions are well remembered, it can be assumed that children who infer and make breakpoints of the main action in each plan scheme would remember that action.

On the other hand, children who make breakpoints of sub, pre, and sequential action would not remember the main action as accurately as children who make breakpoints of the main action would do. Therefore, in this study, the relationship between breakpoint boundaries and memory will be explored.

Traditionally, four- and five-year-old children were not believed to be able to sequence pictures because they lack a concept of causality (Piaget, 1946). But several studies have suggested that picture sequencing tests have nothing to do with causality. When young children were given story-connecting pictures and asked to reconstruct those pictures until they were satisfied, they were able to sequence pictures in the correct order (Brown & French, 1976; Brown & Murphy, 1975). Also, they were able to sequence pictures better when the content of pictures was familiar. Five-year-old children were not be able to sequence pictures even though they could sequence event narratives verbally (Fivush & Slackman, 1986). Nor were they be able to sequence pictures of unfamiliar events. These findings suggest that young children depend on their existing knowledge and can not manipulate it explicitly during picture sequencing as Fivush and Mandler (1985) indicated.

But, as Bornens (1990) indicated, there may be problems with children's reading of pictures. He pointed out that young children have difficulty in the "linking-up process of several pictures into one story." The linking-up process includes understanding the temporal context of pictures. Even though a picture is a static figure, it is a representation of dynamic action. Usually, adults can sequence pictures and tell story because they can represent dynamic nature of actions in pictures. But, young children might have difficulty with understanding of representation mode of pictures. When young children see sequenced pictures, they might see each picture as a separate static figure. This might contribute their difficulty to link up several actions of pictures into a story.

Therefore, temporal context might contribute to competence in picture sequencing in young children. I assumed that if younger children were given temporal contexts of pictures while they organized event knowledge, they would be more likely to sequence pictures in the correct order. Theoretically, the exposition to whole context (or content) of photographs would scaffold temporal context in pictures. But, for children who don't have event knowledge, the access to the temporal context of pictures might not be helpful for picture sequencing.

In order to explore the two main questions in my study, I used a video printer. A video printer is a machine that produces image-like photographs from a videotape of an event by pressing a button. I assumed that children would reflect on an event by segmenting the event on videotape. Five-year-old children may be able to sequence pictures as well as seven-year-old children by establishing event knowledge and accessing the temporal context of pictures while segmenting the event and making pictures.

In my study, I proposed to observe two groups of children to examine the effect of video printer on children's memory of an event and on their picture-sequencing ability at two age levels: five- and seven-years-old. Specifically, I predicted that children who made breakpoints of an event by using a video printer would remember the event better than children who only watched the event on videotape. There would be also developmental differences in the use of organizational strategy and in the subsequent improvement of recall. Furthermore, I thought that five-year-children who generated photographs using a video printer would access the whole context of the photographs and succeed in sequencing the photographs better than children who only watched the event because children who used the videoprinter would have knowledge of both the content and the temporal context of the event in pictures. In order to explore these two main questions, I observed two groups of children. One group of children made photographs of an event from a videotape and were asked to remember the event after they sequenced their own pictures. One day later, they were asked to remember the event, and to sequence their own pictures. The other control group of children was only shown a videotape of the event and were asked to sequence pictures made by other children, and then asked to remember the event they saw. One day later, these children were also asked to remember the event, and then to sequence pictures.

In sum, the effect of a video printer was studied in terms of episodic memory of an arbitrary event. This was done at two developmental levels, age 5 and 7. The effect was tested with both sequencing tasks and free recall.

CHAPTER II
METHODS AND MATERIALS

Subjects

A total of 48 children were sampled from the Amherst area in Massachusetts. Twenty-four 5-year-old children and twenty-four 7-year-old children served as experimental subjects. The children were randomly assigned to one of two treatment conditions. Twelve children in each age group were assigned to the Video Printer Group, and twelve other children in each age group were assigned to the Video Tape Only Group. The mean ages were seven-years and seven months, and five-years and six months for the Video Printer group. For the Video Only group, the mean ages were seven-years and seven months, and five-years and seven months (see Table 2.1).

Materials

Videotape

The videotape consisted of six plans of actions. In the videotape, a man, sitting on a chair by a table, presented a demonstration of how to make a Navaho sand pattern. Only his torso and hands doing the action were seen in the videotape. There were two silver plates on the table; the left one was empty while the right one was full of sand. First, the man named a rake, a sieve, a spoon, a funnel, and a cup that were on the table. Then he showed six steps of actions in the order as follows: 1. He scooped three spoonfuls of

Table 2.1

Mean of Age by Treatment Condition

	Treatment Condition	
Age	Video Printer	Video Only
	Mean	Mean
Five-Year-Old	5yr.6months (1.8)	5yr.7months (1.2)
Seven-Year-Old	7yr.7months (.8)	7yr.7months (.6)

Note: Standard Deviation is in parentheses.

sand into a cup. 2. He shooked a sieve of sand into the plate. 3. He smoothed out the sand with his hand. 4. He raked the sand and made six crossing lines on it. 5. He poured leftover rocks from the sieve into the funnel on the cup. 6. He poured rocks into the cup all around the plate. There were subactions to achieve each goal in these six steps of actions. The pre, main, and subsequent actions in each step are presented in Table 2.1.

This action scheme is made according to Lichtenstein and Brewer (1980). Numbers 2, 5, 8, 12, 15, 18, 21, and 24 are the main actions in the six steps to make a Navaho sand pattern. Numbers 2, 5, 8 are included in one main action category because the same main actions are repeated three times. Numbers 1, 4, 7, 11, 14, 17, 20, 23 are the preactions needed to do the main actions. Numbers 3, 6, 9, 10, 13, 16, 19, 22, 25 are the subsequent actions following the main action. The running time of the videotape was 2 minutes.

Video equipment

The video equipment consisted of a monitor, a video cassette, and a color video printer. All three machines were connected by cable lines. A video printer is a machine that prints color photograph-like images from the videotape. The children were allowed to print whatever images they chose from the videotape on the video monitor. There are two buttons side by side on the video printer. One is for freezing a scene from the videotape. The other is for printing a color photograph of a scene from videotape.

Table 2.2 Action Schemes

Preaction	Main Action (1)	Subsequent Action
1. Take a spoon and scoop sand.	2. Put a spoon of sand in a cup.	3. Take out the spoon from a cup.
4. Take sand with the spoon.	5. Put second spoon of sand in a cup.	6. Take out the spoon from a cup.
7. Take sand with the spoon.	8. Put third spoon of sand in a cup.	9. Take spoon from the cup. 10. Put spoon back down on table.
	Main Action (2)	
11. Pour the cup of sand in a sieve	12. Shave sieve of sand all around pan.	13. Put down the sieve with rocks on the table
	Main Action (3)	
14. Take hand from the table.	15. Smooth sand all around pan with the hand	16. Sprinkle sand off fingers onto sand
	Main Action (4)	
17. Take a rake from the table.	18. Rake sand on plate in cross row pattern.	19. Place rake back on the table.
	Main Action (5)	
20. Place the cup and the sieve on left corner of plate.	21. Pour rocks in the sieve through funnel in the cup.	22. Place the sieve on left corner of plate.
	Main Action (6)	
23. Place the cup of rocks at corner of plate.	24. Pour rocks all around sand plate.	25. Place cup on the table and sit still.

First, children were supposed to press the freeze button, then immediately press the print button. When children pressed the freeze button, the image from the videotape was frozen on the monitor. Then, 60 seconds after a child pressed the print button, a color photograph emerged from the video printer machine.

Research Design

A factorial design of two ages, two treatment conditions, and memory measures with repeated measurement was used. Age was between subjects. Treatment conditions and the three memory measures were within subjects. There were two treatment conditions. In the video print treatment, the children first watched the videotape. Then, they were asked to make six photographs from the videotape. At the first viewing, the children watched the entire tape. Then on the second and third viewings, the children made six video prints on each viewing. In the video only treatment, the children watched the videotape three times, without making any video prints.

All of the children were tested in picture sequencing and free recall during the first session. Children in the video printer group were shown their video prints mixed up. They were asked to arrange these prints in the correct sequence as portrayed in the video tape (**immediate picture sequencing test**). Immediately after they arranged these prints, they were asked to look at these prints and "tell the story" of the making of the Navaho sand pattern (**immediate recall with pictures**). Following this, the pictures were removed and the children were once again asked to tell the story of how the Navaho sand pattern was made (**immediate recall without pictures**). Each child in the video only group was given video prints that were made by the "yoked control" partner from the video printer group. They were asked to arrange these video prints in the correct sequence (**immediate picture sequencing test**). Then they were asked to look at these prints and tell the story of the making of the Navaho sand pattern (**immediate recall with pictures**). Immediately thereafter, the prints were removed and the children were once again asked to tell the story of the making of the Navaho sand pattern (**immediate recall without pictures**). One day later, all the children were invited back. First they were asked to recall the story of the Navaho sand pattern without looking at the video prints or the video tape (**delayed recall without pictures**). Then they were asked to sequence the same video prints they had sequenced the day before (**delayed picture sequencing test**).

The design tested the null hypothesis that there is no significant difference of immediate and delayed picture sequencing between the two treatment conditions: the Video Print group vs. the Video Only group. Also, another null hypothesis was tested that there is a ignificant difference in the three memory measures between the two treatment conditions. Two-way interaction was expected between the two treatment conditions and age in picture sequencing memory. Two-way interaction was also expected between two treatment conditions and age in the three memory measures. It was expected that there would be a relationship between picture quality and each of the three memory measures.

Task Presentation

All children met with an experimenter for two sessions on two consecutive days. On the first day, each child was brought to a spacious room near their classroom. The Video Printer Group was given a brief orientation to the video printer. They were allowed to make two video prints from a tape that bore no content resemblance to the target video. The experimenter explained what a videoprinter is. "This machine is called a color videoprinter. You can make photographs from a videotape using this color videoprinter. I will show you how you can make a photograph." The experimenter took an exercise movie videotape and put it in the videocasette. When the videotape ran, the experimenter asked the child to press the freeze button, then immediately press the print button on the videoprinter. "If you press this button (Freeze) first, then this button (Print) next to it, you will get a photograph from this videotape." After the child seemed to understand the instruction, the child was allowed to make a photograph. "Now, you can make whichever picture you want to have. If you decide to make a picture on this videotape, just press these two buttons but press the left one (Freeze) first." After the child made a photograph, the child was allowed to make another picture if she or he wanted to do so. Then, the experimenter showed the Navaho sand pattern to the child and described it. "Do you know what this is? This is made of sand and rocks. This is called a Navaho sand pattern. Can you say Navaho sand pattern?" After the child said "Navaho sand pattern," the experimenter showed the videotape. "This Navaho sand pattern was made by my friend. My friend on this videotape will show you how to make a Navaho sand pattern." All of the children were shown the videotape once. Then, the following instructions were given to the Video printer and the Video only group respectively.

Video Printer Group

The Video Printer Group was given instructions as follows: "Now I would like you to watch this video again. But this time make six pictures of what you see. After you make six pictures, you have to tell a story of how my friend on the videotape made a Navaho sand pattern by looking at your six pictures. Then, I will mail your six pictures and story to a friend of mine who wants to learn how to make a Navaho sand pattern. You must decide when to press the button. Try to make six pictures that really explain how the Navaho sand pattern was made. That means that you really have to show this friend of mine the steps in making the Navaho sand pattern. By the way, my friend is eight years old and she can learn just from looking at your pictures. But, you must make a good set of pictures that really tell her how to make a Navaho sand pattern." Then, the child was shown the video from the beginning. At any time the child wished, s/he pushed he print button. If the child indicated s/he had passed the picture s/he wanted to make, the child was allowed to make another picture. In this case, the child was asked, "Is this the picture you want to print, or do you want to try again?" If the child said "No", the tape was rewound to the beginning phase of an action s/ he tried to make and the child tried again. If the child said "Yes" the child pushed the print button and waited for the print to emerge from the video printer.

All children in the Video print group were allowed to sequence and fold the photographs they made until all six photographs were made. After all six pictures were made, all pictures were stored away from the child's view. Then, the child was asked to make another six pictures. "Actually, I have another friend who also wants to know about how the man on this videotape made a Navaho sand pattern. Could you make another six pictures for another eight-year-old friend?" The above process was repeated in making the second six pictures. After the child made the second six photographs, the experimenter mixed them up and asked child to sequence them in correct order. "Now, you made these pictures. Can you order these pictures the same way the man on the videotape did?" If the child didn't seem to understand this sequencing instruction, s/he was asked to pick the printed photographs which showed the man on the videotape performing the first action, then the second, third, and so on. They were then asked to lay them out in the correct sequence. They were also asked to retell the event on the videotape with looking at the sequenced pictures. "Now you sequenced the pictures. Could you tell the story of how the man on the videotape made a Navaho sand pattern, while looking at your pictures?"

Video Only Group

These children worked only with the Video Tape and with Video Prints that were made by the other children. They were instructed as follows:

The experimenter showed the Navaho sand pattern and explained what it was made of, and who made it. This was the same instruction that was given to the Video print group. Then, the children were told that they were going to see a videotape of how a man made a Navaho sand pattern. "Now I would like you to watch this videotape three times. On this videotape, my friend will show how he made that Navaho sand pattern. Then, I will give you pictures made from this videotape. You have to order those pictures in the correct order, just as you see them in the videotape. Then, you have to tell a story about how the man made a Navaho sand pattern while looking at those pictures. We will mail these pictures to a friend of mine who wants to learn how to make a Navaho sand pattern. That is, we wants to show this friend of mine the steps in making the sand pattern. By the way, my friend is eight years old and she can learn just by looking at these pictures. But you must arrange these pictures to really tell her how to make the sand pattern." The photographs came from children in the Video Printer group so that each child in the Video Tape Only Group was "yoked" with a child in the Video Printer Group.

Immediate and Delayed Recall

All children were asked to recall what they saw on the videotape after they told a story and the photographs had been taken away. "Could you recall how the man made a Navaho sand pattern?" The next day, all of the children were again tested in picture sequencing and free recall. First, the children were asked to recall what they saw on the videotape, then they were given the pictures they sequenced and were asked to sequence them in the correct order.

Dependent variables and Measurements

In order to look at the effect of the video printer on memory, five different dependent measures were assessed. Three different assessments were used to measure the five dependent variables. First, two dependent variables, immediate and delayed picture sequencing were assessed on the number of positions in which a picture was out of order. The second assessment was used to measure three dependent variables, immediate recall with pictures, immediate recall without pictures and delayed recall without pictures to remember "how to make a Navaho sand pattern" on the videotape. The correct description of each action was scored to a different degree. In order to determine the relationship between breakpoint boundary and each memory measure, picture quality was assessed on the breakpoint boundaries of actions that the children made.

Scores of picture quality ranged according to action scheme: main action, preaction, sequential action. In the following section, descriptions of the three dependent measurements will be elaborated on.

Scores

Memory Score

Scores of verbal protocol ranged from 0 to 3. The criteria of accurate description are based on whether an agent of action and names of objects in the actions were included, and whether the specific detail of an action was described. The most accurate description of a main action was score 3. A general description of a main action was scored 1. If main action is detailed but the name of an object or agent was omitted, the description was scored 2. Details of score in each action are as follows:

Action 1

3. He spooned (or scooped) sand into a cup.
2. He spooned (or put) it into a cup or he put some sand into the cup or spoon and put it into a cup.
1. He used a spoon or he used a cup or he took a cup, spoon or sand into a cup.

Action 2.

3. He shook (sprinkled, poured, or put) sand into a sieve and spread the sand around the pan or the plate.

2. He poured sand around the pan or he poured (shook or put) the sieve around the pan.

1. He put (poured) it in the pan or shook sand or shook sieve.

Action 3.

3. He smoothed the sand with his hand around the pan or he smoothed his hand around the sand.

2. He rubbed sand around the pan or he handed around the pan.

1. He rubbed his hand, he smoothed or he handed around.

Action 4

3. He raked top to down, side to side or he made crosslines with a rake or he made six lines with a rake.

2. He raked lines, he made six lines on it, or he made lines with a rake.

1. He used a rake, he made a tictac-toe, he made lines, or raked it.

Action 5.

3. He put a funnel on top of a cup and poured rocks from the sieve into a cup or he poured rocks from the sieve into a funnel, then into the cup.

2. He put a funnel and poured rocks into a cup or he poured rocks from a sieve into a funnel (or a cup).

1. He took a funnel, or he took a cup, or he took a sieve, or he poured rocks from a sieve or poured rocks into a cup.

Action 6.

3. He poured rocks in a cup all around the pan, or he poured rocks from a cup all around the tray.

2. He poured the rocks into a cup, or he poured rocks around the pan.

1. He sprinkled (poured) it on the pan, cup poured sand, he poured rocks.

<u>Picture Sequencing Score</u>

Each child received a score for how well s/he sequenced the video prints, those made in the Video Printer group and those presented to in the Video Only group. A score of 1 was given to a photograph that was one step out of sequence; a 2 score was given to a photograph that was two steps out of sequence. All scores of misordered photographs for each child were added up. This score was then subtracted from the maximum possible value of 19. If the sequence of the photographs was 653421, for example, then the score of the misorder of photographs was 18. In this case, the minimum score was 1. Thus, the scores ranged from a minimum of 1 to a maximum of 19.

Picture Quality Score

The quality of each picture the children made was evaluated by an action scheme. If a child made a photograph of a main action, the child was given a score of 3. If the photograph concerned pre and subsequent action, a score of 1 was given. Some children made less than six photographs. Thus, if no photograph was made of main, pre, or subsequent action in one action category, a score of 0 was given.

CHAPTER III

EFFECT OF VIDEO PRINTER -RESULTS AND DISCUSSION

To measure the effects of the video printer on memory, an analysis of variance with repeated measures was used to analyze a design 2 (age) x 2 (treatment conditions) x 3 (three memory measures) for recall, and 2 (age) x 2 (treatment condition) x 2 (two sequence types) for picture sequencing. Dependent variables were differences on each of the five scores: Immediate picture sequencing, delayed picture sequencing, immediate recall with pictures, immediate recall without pictures, and delayed recall without pictures. There was no three-way interaction. There was significant two-way interaction between age and treatment conditions for the three memory measures. But, there was no significant two-way interaction between age and condition for picture sequencing. Also, there was no three-way interaction.

Recall

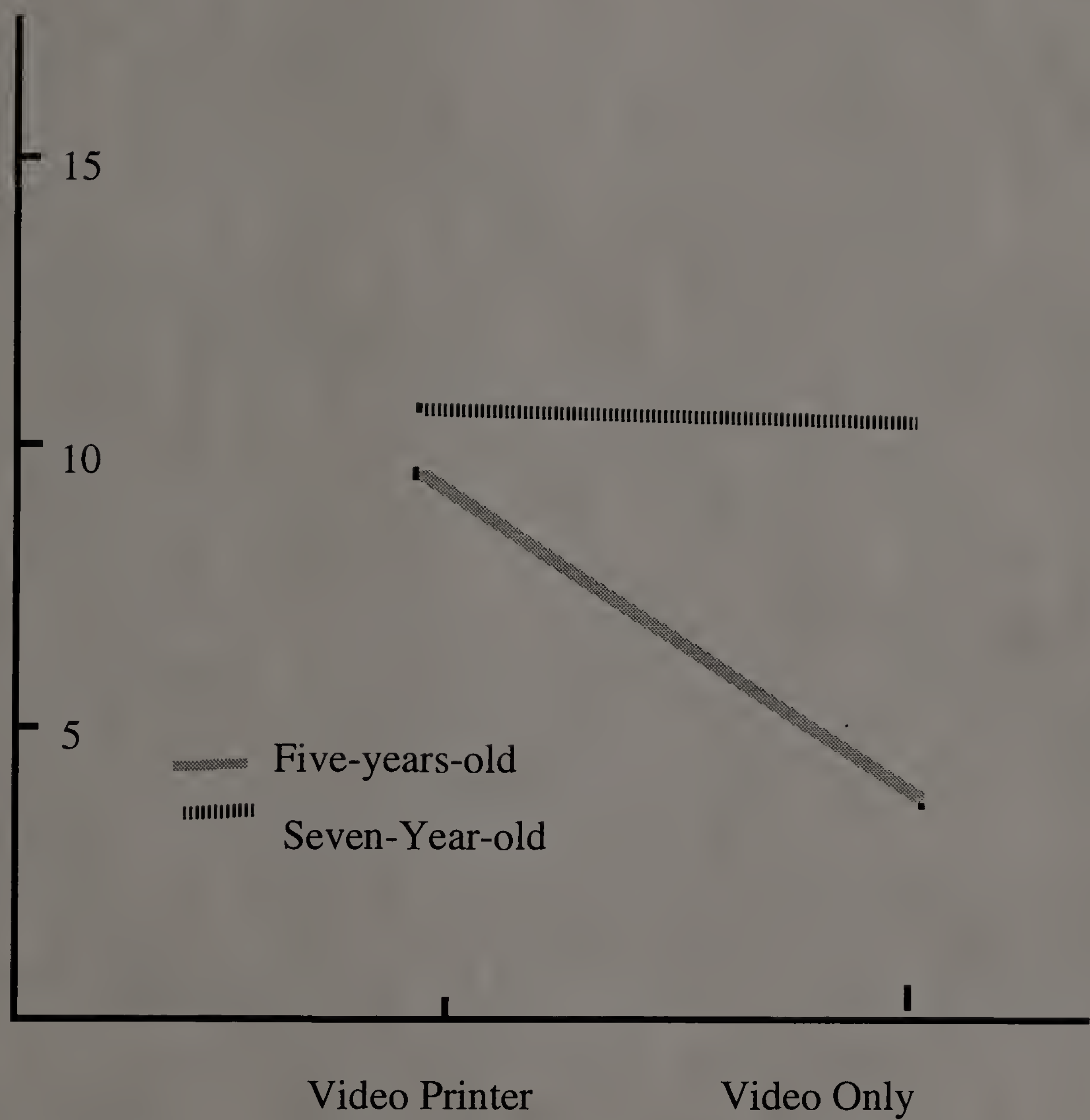
Treatment by age

There was two-way interaction for treatment and age ($F=.000$, $P<.05$) (see Table 3.1). And there were main effects for treatment ($F=.000$, $P<.05$) and age ($F=.000$, $P<.05$). As indicated in Table 3.2 and Graph 3.1, there were significant mean differences between the Video Printer and Video Only group for the five-year-old children. In order to see the interaction effect of age and treatment specifically, Manova was used (see Table 3.3). There were significant differences of two treatment conditions for each memory measure in five-year-old children (Immediate recall with pictures ($F=.000$, $P<.05$), immediate recall without pictures ($F=.000$, $P<.05$), and delayed recall without pictures ($F=.000$, $P<.05$). But, there were no significant differences of two treatment conditions for each memory measure in seven-year-old children (immediate recall with pictures ($F=.461$, $P>.05$), immediate recall without pictures ($F=.579$, $P>.05$), delayed recall without pictures ($F=.712$, $P>.05$). Therefore, the two-way interaction between age and treatment conditions is due to significant mean differences in each memory measure for five-year-old children. To show details of mean differences for the three memory measures in each age group, each mean is described in Table 3.4 and Graph 1. As seen in Table 3.4, there was little mean difference in memory scores between treatment conditions for seven-year-old children. On the other hand, there were distinct mean differences between treatment conditions for five-year-old children. The lower memory ability of five-year-old children in the Video Only group confirms the result of studies in which five-year-old children could not remember episodic events whereas older children could remember them (Hudson & Fusion, 1983). Five-year-old children could not remember details of an event even after experiencing them (Hudson, 1985). But, in the present study, five-year-old children in the video printer group remembered an episodic event three times as children in the Video Only group did. Obviously, five-year-old children did benefit when they were

Table 3.1

Anova Showing Memory Measures by Treatment by Age

Source of Variation	SS	DF	MS	F	Sig of F
Age	1072.56	1	1072.56		.000*
Within Group Error1	407.76	22	18.53		
Treatment	364.17	1	364.1	52.45	.000*
Treatment by Age	297.56	1	297.56	42.83	.000*
Within Group Error2	152.76	22	6.94		
Three Memory Measures	11.43	2	5.72	1.4	0.257
Three Memory Measures by Age	11.62	2	5.81	1.42	0.252
Within Group Error3	179.61	44	4.08		
Treatment by Three Memory Measures	1.85	2	0.92	0.21	0.815
Age by Treatment by Three Memory Measures	2.38	2	1.19	0.26	0.769
Within Group Error4	197.78	44	4.49		*P <.01



Graph 3.1 The Mean Differences of Memory Measures

Table 3.2

Mean of Memory Measures

Age	Treatment Condition	
	Video Printer	Video Only
Five-Year-old	9.5 (2.5)	3.5(3.19)
Seven-Year-Old	12.1(2.3)	11.8(2.3)

Standard Deviation is in Parenthesis

Table 3.3

Anova Showing Treatment Differences for Each Memory within Age Group

Anova for Immediate Recall with Pictures

Source of Variation	SS	DF	MS	F	Sig of F
Five-Year-Old	204.17	1	204.17		.000*
Seven-Year-Old	2.67	1	2.67		.461
Within Group Error	104.17	22	4.73		

Anova for Immediate Recall without Pictures

Source of Variation	SS	DF	MS	F	Sig of F
Five-Year-Old	234.38	1	234.38		.000*
Seven-Year-Old	2.04	1	0.32		.579
Within Group Error	141.58	22	6.44		

Anova for Delayed Recall without Pictures

Source of Variation	SS	DF	MS	F	Sig of F
Five-Year-Old	222.04	1	46.62		.000*
Seven-Year-Old	0.67	1	0.14		.712
Within Group Error	104.79	22	4.76		

* $P < .01$

Table 3.4

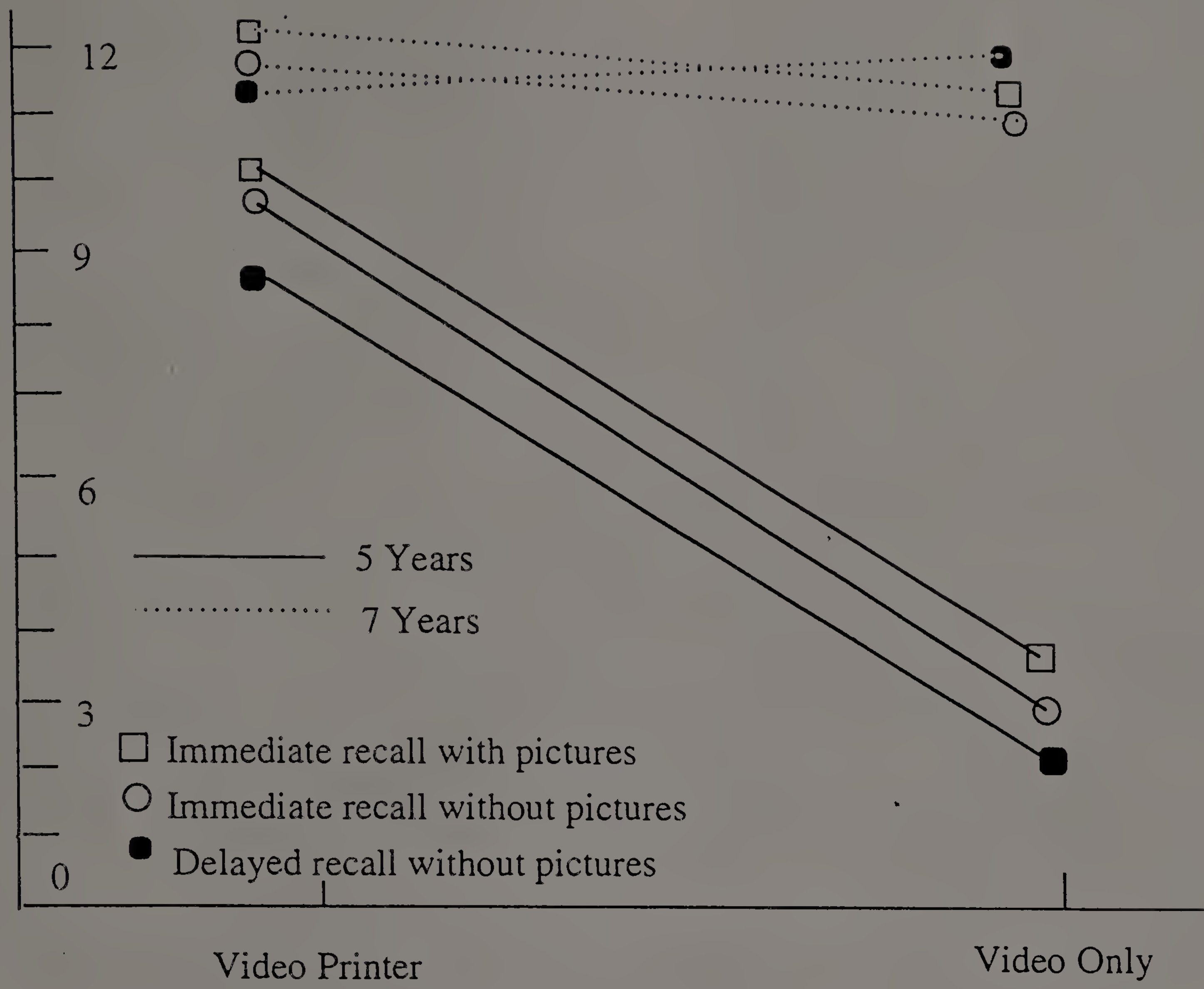
Mean of Each Memory Measure by Age in Each Treatment

	Immediate Recall with Pictures	
	Treat ment Condition	
Age	Video Printer	Video Only
Five-Year-Old	10.08(2.90)	4.25(2.63)
Seven-Year-Old	12.33(2.60)	11.66(2.74)

	Immediate Recall without Pictures	
	Treatment Conditions	
Age	Video Printer	Video Only
Five-Year-Old	9.75(2.80)	3.50(3.45)
Seven-Year-Old	12.25(1.86)	11.66(2.74)

	Delayed Recall without Pictures	
	Treatment Conditions	
Age	Video Printer	Video Only
Five-Year-Old	8.83(1.94)	2.75(3.49)
Seven-Year-Old	11.83(2.58)	12.16(1.52)

Standard Deviation is parenthesis



Graphs 3.2 The Mean Differences of Three Memory Measures

induced to use organizational strategy. The five-year-old children obviously benefited in memory improvement by using the video printer machine, but seven-year-old children did not benefit either because the episodic event used in the present study was too simple to measure the effect of a video printer on seven-year-old children's memories or because the video printer itself is a useless tool for helping seven-year-old children's remembering. If a slightly more difficult task of an episodic event is constructed, we would discover

Table 3.5

Anova Showing Age Differences within Treatment Condition

	Anova for Immediate Recall with Pictures				
Source of Variation	SS	DF	MS	F	Sig of F
Video Printer	30.37	1	30.37	3.99	.058
Type 1 Error	167.58	22	7.62		
Vido Only	330.04	1	330.04	45.69	.000*
Type 2 Error	158.92	22	7.22		
	Anova for Immediate Recall without Pictures				
Source of Variation	SS	DF	MS	F	Sig of F
Video Printer	37.5	1	37.5	6.63	.017*
Type 1 Error	124.5	22	5.66		
Video Only	400.17	1	400.17	41.59	.000*
Type 2 Error	211.67	22	9.62		
	Anova for Delayed Recall without Pictures				
Source of Variation	SS	DF	MS	F	Sig of F
Video Printer	54	1	54	10.3	.004*
Type 1 Error	115.33	22	5.24		
Video Only	532.04	1	532.04	73.19	.000*
Type 2 Error	159.92	22	7.27		

* $P<.05$

whether a video printer is a good instrument for helping seven-year-old children to remember an episodic event. This issue must be further explored.

Recall type by Age by Treatment

There were no significant differences among immediate recall with pictures, immediate recall or delayed recall without pictures (F=.257, P>.05) (see Table 3.1). There were no three-way interactions between the age, three memory measures, or treatment (F=.769, P>.05). There were also no two-way interactions (F=.815, P>.05). As indicated in Table 3.3, the mean score of each memory measure in each age group is similar. Mean scores of five-year-old children's immediate recall with pictures, immediate recall or delayed recall without pictures were 10.8 (SD=2.90), 9.75 (SD=2.80), 8.83 (SD=1.94). Seven-year-old children's mean scores were 12 (SD=2.60), 12 (SD=1.86), and 11 (2.58) for immediate recall with pictures, immediate and delayed recall without pictures, respectively. Surprisingly, for five-year-old children in the Video Only group, the mean scores of the three memory measures were similar. In other words, the mean score of immediate recall with pictures lasted up to one day after free recall regardless of treatment conditions and age. This result is impressive in that five-year-old children could remember an episodic event for one day.

Discussion

The effect of the Video printer on event memory of five-year-old children is obvious in the present study. When five-year-old children segmented an event and made pictures by using the Video printer, they seemed to use certain strategies to remember that event. One study showed that five-year-old children improved their event memory after they sequenced pictures of the event such as going to the doctor or going to the store (Catellani, 1991). If sequencing is the only reason that five-year-old children in the Video Printer group improved their memory of an episodic event in the present study, then the memories of the Video Only group should be the same as those in the Video Printer group. Children in the Video Only group went through the same experimental procedures as those in the Video Printer group except for making pictures by using the Video Printer. But, as indicated in the present results, five-year-old children in the Video Printer group remembered an episodic event three times more frequently than children in the Video Only group. Thus, there must be other psychological factors that can explain these results in the process of making breakpoints with and taking pictures from the Video Printer. If a child was able to recall an event with pictures, s/he maintained the recall one day later in the present study regardless of treatment conditions. Thus, children in the Video Printer group must have used unknown strategies before they sequenced pictures and told a story about them. Several possible strategies may have been employed by children in the Video Printer group.

Making breakpoints has been found to have cognitive effects on adults. Newtson (1973) used the breakpoint method to explore how a person's perception of events influence his or her cognition. In his study, adults were given a button that was connected to a computer monitor and then asked to press the button whenever they they saw meaningful units of an event on a videotape. Generally, adults were better able to infer personality traits such as attitude and problem-solving ability (Newtson & Engquist,1976) when they divided the events into small units. The breakpoint technique was also found to affect the memory of adults. Hanson and Hirst (1989) found that adults could recall an episodic event well when they broke the event from a videotape into the smallest units; otherwise, the event was not recalled very well.

The results of these studies are applicable to the present result: children might encode events in depth when they were allowed to establish breakpoint boundaries. But, it seems premature to think that children benefited solely from making breakpoints of an event from the videotape because there may have been other psychological factors involved.

Childen might use a rehearsal strategy when they organize an event into plan schemes and makes breakpoints of actions. When the children made a breakpoint of the event by using the video printer, they might or might not have used covert rehearsal. Some five-year-old children in the Video Only group could not remember the event at all even when looking at pictures even though they could sequence the pictures in the correct order. These children might have attended only to images on the video tape. Also, four-year-old children in the Video Printer group from my pilot study showed that they could not tell a story at all even when looking pictures they made. Four-year-old children might encode information visually but they might not be able to process semantic information of the event. Therefore, five-year-old children in Video Printer group seemed to use organizational and covert rehearsal strategy when they segmented the event.

Picture Sequence

Sequence Types by Treatment by Age

There was no significant three-way interaction among age, treatment, and sequencing type (F=.156, P>.05) (see Table 3.6). There was no two-way interaction between age and treatment (F=.168, P>.05) (see Table 3.6). There was also no two-way interaction between age and sequencing (F=.192, P>.05). But, there was a main effect in each picture sequencing type and treatment condition.

Main Effects

There was a main effect for treatment (F=.01, P<.05) (see Table 3. 5). Mean scores of children in the Video Printer group were higher (M=18.54, SD=1.28) than those in the Video Only group (M=16.52, SD=3.66) (see Table 7). There was no main effect for age (F=.05, P=.05). But, there was a main effect (F=.021, P<.05) (see Table 3. 6) for sequence type: immediate and delayed picture sequencing.

Table 3.6

Anova for Picture Sequencing by Age by Treatment by Sequence Type

Source of Variation	SS	DF	MS	F	Sig of F
Treatment Condition	98.01	1	98.01	7.95	0.01*
Treatment Condition by age	25.01	1	25.01	2.03	0.168
Within Group Error 1	271.23	22	12.33		
Sequence Type	12.76	1	12.76	6.14	0.021
Sequence Type by Age	3.76	1	3.76	1.81	0.192
Within Group Error 2	45.73	22	2.08		
Sequence Type by Treatment	5.51	1	5.51	2.16	0.156
Sequence Type by Treatment by Age	0.51	1	0.51	0.2	0.659
Within Group Error3	45.73	22	2.08		
Age	61.76	1	61.76	4.08	0.56
Within Group Error4	333.4	22	15.15		*P<.05

Mean score of delayed picture sequencing (M=17.90, SD=1.71) was higher than immediate picture sequencing (M=17, SD=2.60) (see Table 3.7 Graph 3.3). All children in Video Printer group sequenced pictures better in correct order than those in the Video Only group. In the present study, results of the Video Only group seem to replicate other studies stating that five-year-old children lack the ability to sequence pictures of arbitrary or episodic events. Five-year-old children in the Video Printer group benefited from using a video printer for picture sequencing.

Table 3.7
Mean for Picture Sequence by Treatment and Sequence Type

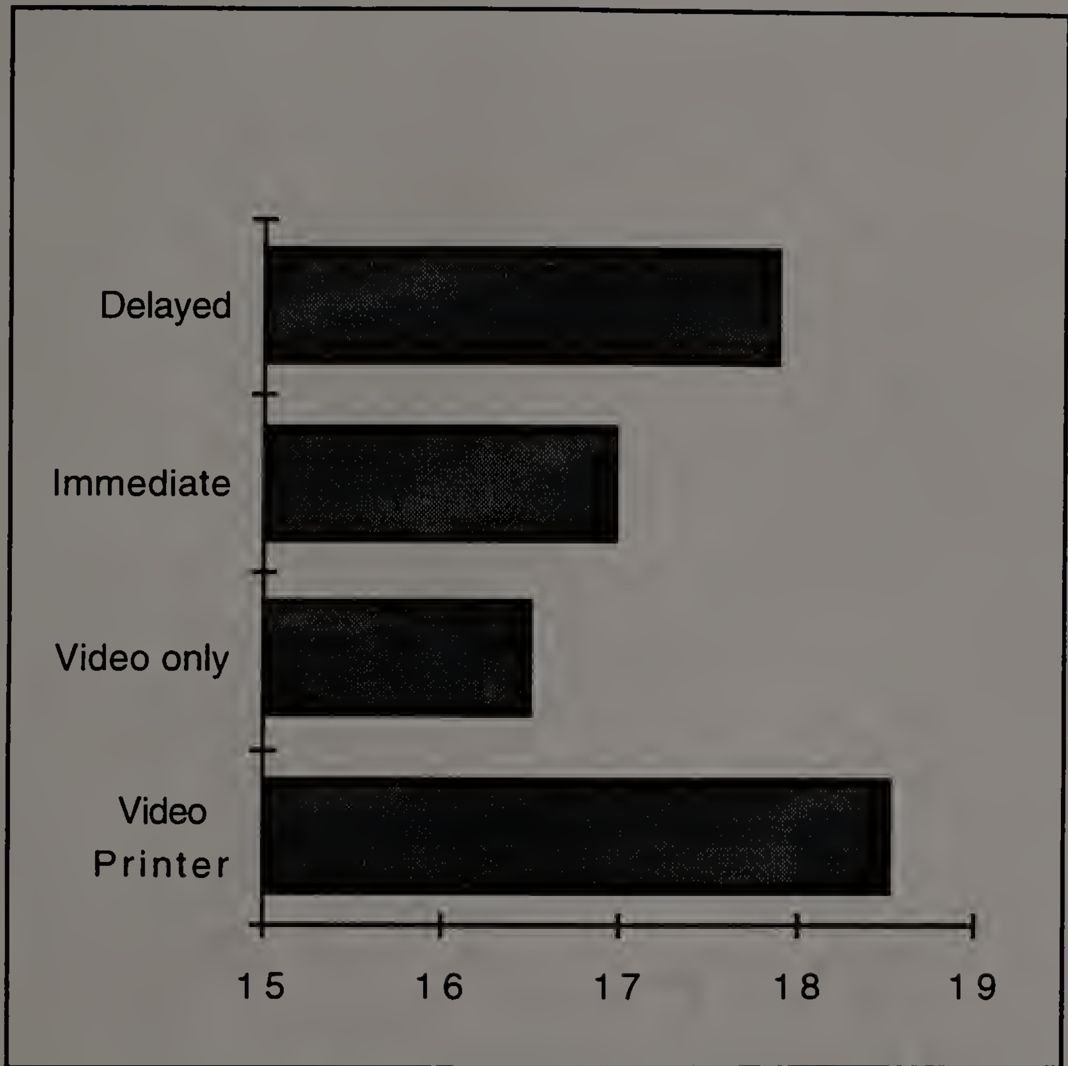
	Treatment Condition	
	Video Printer	Video Only
Mean	18.54(1.28)	16.52(3.66)

	Sequence Type	
	Immediate	Delayed
Mean	17(2.60)	17.90(1.71)

Standard Deviation is in parenthesis

This result shows the same effect of using the Video printer for picture sequencing memory as indicated in its effect on the recall of an episodic event. Unexpectedly, seven-year-old children also benefitted from using a video printer for picture sequencing.

Seven-year-old children were found to be able to sequence pictures of familiar events without prompting. But, with an unfamiliar event, they seemed to benefit from using the video



Graph 3.3 The Mean Differences of Picture Sequence

printer because they could sequences pictures of the event better than children who only watched the event.

Surprisingly, there were significant differences between immediate and delayed sequences even though there seemed to be small mean differences: delayed picture sequence (M=17.90, SD=1.71); and immediate picture sequence (M=17, SD=2.60).

Several children who sequenced pictures poorly during immediate picture sequencing improved their performance drastically. There might be possible effects from practice. After immediate picture sequencing, all children were asked two times to recall "how to make a Navaho Sand Pattern" on the videotape: the first one was an immediate recall, the second one was an one-day-delayed recall. The experience of these recalls and immediate picture sequencing might have contributed to the improvement in their ability to sequence the pictures one day later. This issue must be further explored.

Picture Quality and Memory

Picture Quality

Because all children were asked to make six pictures, they should have inferred six main actions from whole sequences of

Table 3.8

T test for Picture Quality
by Age

Age	N	Mean	SD	DF	T	Prob
Five-Year-Old	12	11.83	2.55	21.95	2.21	
Seven-Year-Old	12	14.08	2.42			.038*

*P<.05

actions to tell the story in six steps. I predicted that there would be developmental differences related to organizational strategy between seven- and five-year-old children's ability to make pictures of six main actions. To determine if there were significant differences between the two groups, a T test was used. As predicted, there were significant differences between seven- and five-year-old children ($F=.038$, $P<.05$). As can be seen from Table 3.8, the mean score of seven-year-old children is higher ($M=14.08$) than the mean score (11.83) of five-year-old children.

<u>Relationship of Picture Quality and Recall</u>

It was assumed that the children's memory would be better if they made good breakpoints of sub-main actions. All pictures that were made by children were judged to be nonbreakpoint or breakpoint. If children made a picture of a main action, the picture was evaluated as a breakpoint. Nonbreakpoints of an event consist of pre-actions and subsequent actions. A Spearman Correlation Coefficient was derived for collapsed age. For the Videoprinter group (see Table 3.9), there was a significant relationship between the quality of the pictures and immediate recall with pictures in Main Action 3, 4, 6. Even though there was no significant correlation between picture quality and immediate recall with pictures in other main actions, it almost reached sgnificant levels. But, for Main Action 1, the correlation was distinctly low. For this action, there might be a primacy effect. As a result, children might remember this first action regardless of picture quality. There were no significant relationships between picture quality and immediate and delayed recall without pictures except for the case of Main Action 3 for immediate recall without pictures and Main action 2 for delayed recall without pictures. There was not much relationship between picture quality and these two memories in the Video Printer group but these correlations are relatively higher than correlations in the Video Only group. For the Video Only group (see Table 3.10), there was no relationship between picture quality and immediate recall with pictures, or immediate- and delayed-recall without pictures except for immediate recall without pictures in Main Action 6. Therefore, the cue itself is only useful when it is self-generated.

The relationship between picture quality and memory seems to depend on the nature of sub action. Compared to actions of plan scheme 3, 4, and 6, actions of plan scheme 2 and 5 were complicated. Plan schemes 3, 4, and 6 consisted of one preaction, one main action, and one subsequent action. In order to achieve plan schemes 2 and 5, there needed to be more than one preaction or subsequent action. For example, the actor on the videotape (a) took a sieve and (b) poured sand into a cup and then into a sieve, (c) then put the cup down on the table. The actor then (d) shook the sieve around the plate (d) and (e) put the sieve back on the table. The main action is d. The subsequent action is e and the preactions are a, b, and c.Similarly, for the plan scheme 5, there are several steps needed to achieve the main action. In plan scheme 5, the actor on the videotape (f) put the cup down inside the sand on the plate, (g) put the funnel on the cup, (h) took a sieve full of rocks (i) poured the rocks into the funnel that goes into the cup, (j) put the sieve back on the table, and (k) put the funnel back on the table. Children might have difficulty in describing all these actions with one static moment of action in a picture. For the Video Printer group, correlations between picture quality and memory decreased with time. Without

Table 3.9

Spearman Correlations Showing Relationship between Three Each Memory Measure and Picture Quality in Six Main Action (Video Printer Group)

Each Memory	Main Action	Picture Quality 1	2	3	4	5	6
Imm. with Pic.	1	r=.1069 P=.741					
	2		r=.5409 P=.069				
	3			r=.7127 *P=.009			
	4				r=.5869 *P=.045		
	5					r=.5409 P=.0669	
	6						r=.6606 *P=.019
Imm. without Pic.	1	r=-.8281 * p=.001					
	2		r=.3786 P=.225				
	3			r=.6990 * P=.011			
	4				r=.4868 P=.109		
	5					r=.4787 P=.115	
	6						r=.4226 P=.171
Del.without Pic.	1	r=-.2342 P=.464					
	2		r=.6110 *P=.035				
	3			r=.5410 P=.069			
	4				r=.3636 P=.245		
	5					r=.3840 P=.218	
	6						r=.1429 P=.658

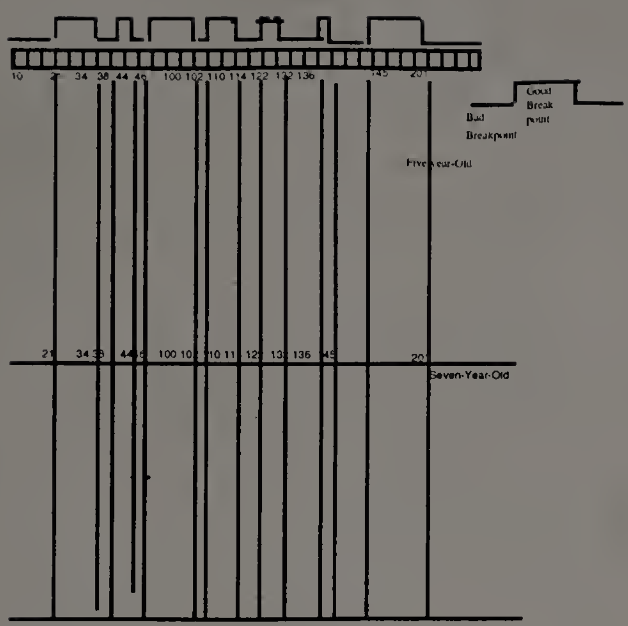
Note. Imm.=Immediate Memory; Del=Delayed Memory; Pic.=Pictures *P <.05

Table 3.10

Spearman Correlations Showing Relationships between Three Each Memory Measure and Picture Quality score in Six Main Action (Video Only Group)

Each Memory	Main Action	Picture Quality 1	2	3	4	5	6
Imm. with Pic.	1	r=-.2302 P=.472					
	2		r=-.1910 P=.552				
	3			r=.2171 P=.498			
	4				r=.3628 P=.246		
	5					r=.3062 P=.333	
	6						r=.1658 P=.606
Imm. without Pic.	1	r=.1296 P=.680					
	2		r=-.1793 P=.577				
	3			r=.4880 P=.108			
	4				r=.3612 P=.249		
	5					r=.0000 P=1.00	
	6						r=.7628 *P=.004
Del. without Pic.	1	r=.1577 P=.624					
	2		r=-.5367 P=.072				
	3			r=.4020 P=.195			
	4				r=.3101 P=.327		
	5					r=.0000 P=1.00	
	6						r=.0636 P=.844

Note. Imm.=Immediate Memory; Del.=Delayed Memory; Pic.=Pictures
* P<.05



Graph 3.4 Scattergram Showing Breakpoints of Pictures

Without pictures, children would not be reminded of the sequences of actions on the videotape. Therefore, they might forget details of the actions with time.

CHAPTER IV
SUMMARY AND CONCLUSION

The main purpose of this study was to explore the effects of video printer technology on children's memory. It was predicted that five-year-old children would improve their memory by reflecting on an event by using a video printer. As predicted, five-year-old children who made pictures of an event remembered better than those who only watched the event. While interacting with the video printer, children must be induced to reflect on the event by deciding when to make breakpoints. In order to make six pictures for telling the six steps of " How to Make a Navaho Sand Pattern," they had to abstract ongoing actions into six schemes from the videotape of the event.

This information processing first would trigger information on plan schemes of actions leading to the goal. After that, the children had to infer which action was the main action, and pre, and subsequent actions among each plan scheme of actions. During this information processing, the children had to access semantic information in their memory. This semantic access might have led five-year-old children in the Video Printer group to remember the event almost three times as well as children who only watched the event. For organization as well as inference of information, five-year-old children might need to expend heavy mental effort. It is impressive that five-year-old children remembered an event very well despite this cost. Traditionally, five-year-old children were not believed to use mnemonic strategies or to benefit from explicit training in these strategies. But, as indicated in the present study, five-year-old children benefitted when they were induced to use organizational strategy.

Memory strategies were believed to play an important role in the remembering of words and digits. Studies of memory strategies have indicated that mnemonic strategies such as categorical organizational strategy, key-word strategy, and mental effort at encoding may help young children to store information for a longer time period (Carr & Schneider, 1991; Pressley, Borkowski, & Schneider, 1987). There were also reported developmental differences in the use of these strategies. In general, five-year-old children were found not to spontaneously use these strategies whereas older children were found to do so (Bjorklund et al., 1977). But, five-year-old children were able to use these strategies if given explicit training (Ornstein et al, 1985). Explicit training in these strategies was not found to improve recall in young children (Bjorklund & Harnishfeger, 1987; Carr & Schneider, 1991). And, the lack of generalization of learned strategy to other areas has been criticized (Bjorklund et al., 1977; Ringel & Springer, 1980). Several studies (Best, 1993; Best & Ornstein, 1986) have indicated that young children improved their recall when they were induced to use organizational strategy. Thus, younger children's spontaneous use of mnemonic strategy might be appropriate if they can be induced to use it.

The effectiveness of the spontaneous use of mnemonic strategy was shown in the present study. In this study, five-year-old children were induced to organize and segment an event by themselves. With the instruction of "making six pictures to tell a story," they organized an event into meaningful units by themselves. The five-year-old children in the Video printer group showed better recall than those who only watched the event.

Children in the Video Printer group were induced to organize the event into plan schemes leading to a goal by being told to "Make six pictures to tell a story about how to make a Navaho Sand Pattern." Therefore, the children who were given these instruction had to decide on six plans leading to a goal while they watched the event on a videotape. During this process, they had to think about each plan in terms of its goal. As a result, the children made decisions of how to organize plans in terms of six relations to make a Navaho Sand Pattern from the videotape. I assumed that this organization would access semantic memory. The evidence for this seems to come from the five-year-old children's ability to remember the event one day later. If the children had not accessed semantic memory, they could not have maintained the memory of the event during the immediate recall and one day later recall.

There were other possible mnemonic strategies used during the five-year-old children's interaction with the video printer in this study. One possible strategy was rehearsal. The five-year-old children in the Video Printer group could articulate six steps with pictures almost as well as seven-year-old children, even though the mean score of the seven-year-old children was higher than that of the five-year-old children. But, many five-year-old children who only watched the event could not articulate the event with the pictures as cues. These children could not recall the six steps even with pictures of the event. And few of them recalled the event with pictures. This evidence implies that five-year-old children in the Video Only group did not rehearse while they watched the event whereas five-year-old children in the Video Printer group rehearsed while they segmented the event.

Organizational strategy and rehearsal may not be separate processes in this study. When children in the Video Printer group segmented ongoing actions into six plan schemes, they rehearsed those plans leading to a goal. Elaborative rehearsal occurs when the material is organized into certain types (Feldman, 1993). But, it is premature to think that five-year-old children in the Video printer group used rehearsal strategy when they organized ongoing actions of the event into meaningful units in this study. The five-year-old children were not asked to tell whether they used covert rehearsal. Future studies must explore this issue.

Five-year-old children benefitted from using organizational strategy for their event memory but there were still developmental differences in event memory when children were induced to use organizational strategy with a video printer. Also, five-year-old children's organizational strategy was inferior to seven-year-old children's. This finding seem to replicate traditional studies indicating that older children use better mnemonic strategies than younger children.

All children in the Video Printer group seemed to use mnemonic strategies but its effectiveness on memory depended on the way in which they inferred six main actions in each plan scheme. There was a correlation between picture quality and immediate recall with pictures in this study. Children who made pictures of the main action were able to accurately remember that action. On the other hand, children who made pictures of pre or subsequent actions could not remember the main action very well. This result confirms the research of Newtson and Engquist (1976) and Hanson and Hirst (1989), who found that perceived breakpoint boundaries of an event were better remembered through segmentation of the event. Even though its correlation decreased with time, picture quality seems to have a relative effect on memory when compared with children who only watched an event. There were no relationships between picture quality and memory in children who only watched the event. This result seems to support the evidence that children in the Video Printer group were representing information rather than merely pushing the button on a video printer when they segmented the event from the videotape. Even though there were relationships between picture quality and immediate recall with pictures, the nature of the event seems to influence the relation. Specifically, there were strong relationships between the picture quality of simple actions and immediate recall with pictures. But, for the more complex actions, children seemed to have a little more difficulty describing those actions accurately. As a result, there were weak relationships between picture quality and accuracy in recall with pictures for those actions In general, children who reflected on an event by determining breakpoints remembered the event better than children who only watched it. The validity of this finding seems to be in the finding of a correlation between picture quality and memory.

The second purpose of this study was to explore the effect of using a video printer on the picture sequencing ability of young children. Previous research held that five-year-old children could not sequence pictures of an event even though the event was familiar (Piaget, 1946). This finding indicates that five-year-old children did not have the ability to manipulate explicitly their existing script knowledge (Fivush & Slackman, 1986). But, a recent study suggested that the failure to sequence pictures might be attributed to the inability to understand "temporal context" (Bornens, 1990 In order to know the effect of "temporal contexts" on children's picture sequencing, children were exposed to the "temporal contexts" of pictures in this study. Children in this study could access the temporal context of pictures either by making their own pictures from the videotape of an event or by only watching the videotape. I assumed that even though children in both the Video Printer and the Video Only group could access the temporal context of pictures, five-year-old children in the Video Printer group might perform better than those in the Video Only group because the children who generated their own pictures might have established a script of the event by segmenting the event.

As predicted, all children who printed their own pictures could sequence those pictures better than children who only watched the event. But, for seven-year-old children, there were significant differences in picture sequencing ability between the Video only group and the Video Printer group. Actually, this result was unexpected. Seven-year-old children were believed to understand temporal context only if the event was familiar. In this study, even though the task was new and unfamiliar, the children were supposed to become familiar with that event either by establishing a script of the event or by watching or segmenting the event. In this study, there were no differences in recalls between the Video Printer and Video Only group for seven-year-old children. Therefore, content knowledge of those pictures did not seem to be a main reason for the better performance of picture sequencing by the seven-year-old children in the Video Printer group. The better performance of seven-year-old children in the Video Printer group might be attributed to explicit manipulation. Children in the Video Printer group counted, mixed, and sequenced their own pictures while they made them. This manipulation might have contributed to the improvement in their later performance. On the contrary, children who only watched an event were given pictures made by other children. As a result, they were deprived of the opportunity to manipulate the pictures. In order to be able to sequence pictures, young children must have the content knowledge as well as the temporal context of the pictures. In addition, explicit manipulation also seems to contribute to better performance in the picture sequencing ability of younger and older children.

Surprisingly, children were able to sequence pictures better one day later than they were immediately regardless of age. These children might benefit from practice. Children immediately recalled the event with those pictures after picture sequencing and then recalled the event without pictures before the one-day delayed picture sequence. Two recall practices must contribute to the improvement of ability to sequence pictures in the children. This issue must be further explored.

In general, five-year-old children improved their event memory when they were induced to use organizational strategy with a video printer. This finding in the present study seems to provide insight on present developmental theory of children's script knowledge. Unlike present developmental theory, which states that five-year-old children depend on their own script knowledge when they remember new episodic events, they were found to establish a new script even after one experience if they were induced to use mnemonic strategy in the present study. Even though five-year-old children remembered details of the event, there was still a developmental difference in event memory after the five-year-old children used an organizational strategy. There are several reasons for the developmental differences shown in the present study. As indicated in the findings of this study, the seven-year-old children used better organizational strategy than the five-year-old children. Seven-year-old children segmented the event into better breakpoints than five-year-old children. The good breakpoints of the event consisted of main action whereas bad breakpoints of the event consisted of pre-and subsequent actions. Main actions of the event indicate achieving subgoals of a plan leading to a goal. Pre-and subsequent actions also are actions leading to a subgoal. These actions are goal-directed but these are not main actions. When children make breakpoints into these actions, they would attend to the enabling relationship. As a result, they can not remember the details of the main actions. Therefore, seven-year-old children would remembered the event better than five-year-old children because they orgnized the event into good breakpoints. Another factor contributing to developmental differences might be knowledge difference. Even though the task in this study was unfamiliar to both five- and seven-year-old children, seven-year-old children might have more knowledge base than five-year-old children to access semantic memory. This issue must be further explored.

Educational Implication

The educational implications of this study seem to be obvious. In kindergarten, there is journal time. Children are asked to reflect on their experiences at home or school and to make drawings and write one or two words about those experience. In one kindergarten table, five children made whatever they wanted with straws. The children made a space ship, house, flower, etc. The teacher asked children in that table to write in their journal about that experience. Those children were then asked to share what they had written in their journals. Each child said "I made a spaceship, I made a flower...". I wondered what they would have said if they were asked to tell "how did you make it?" I guessed that they could not remember how they made it. In many learning situations, it is possible that children process information mindlessly. If those children made pictures of their own experiences by using a video printer and wrote in a journal with those pictures, they would then reflect on the process of how they made a spaceship or flowers. In addition, the vocabulary of their description would be richer. Therefore, a video printer seems to be a good tool for five-year-old children to reflect on their own experience as well as to mindfully process events they experience.

Another educational value of a video printer seems to be motivation. Many five-year-old children were interested in making pictures of the event by using the video printer in the present study. This effect might increase if children made pictures of their own activity with the video printer. In my pilot study, I recorded children's activity on videotape. Children showed intensive interest in making pictures of their own activity. Different children seemed to attend to different aspects of the activities. Boys made pictures dynamic actions and described the action in those pictures but girls made pictures of static poses. It may be premature to think that there are sex difference in attending to their own activity from a videotape and making pictures. But it deserves to be explored.

The limitation of the study

Even though this study showed the usefulness of a video printer in improving event memory in five-year-old children, there were several limitations in the research design and experimental procedure. Children in the Video printer group spent 14 minutes in making pictures whereas children who only watched the videotape spent only four minutes viewing it. Therefore, the better performance of the five-year-old children in the Video Printer group could be attributed to the increased time they spent on the task. On the other hand, there were possible interferences with the memory of the children in the Video Printer group. All children in the Video printer group were distracted by the sound of the machine and the pictures coming slowly out of the small box on the video printer. Therefore, they did not seem to take full advantage of the amount of time spent making pictures. Following studies must explore these issues.

Another problem of this study was the possibility of compounding factors. Five-year-old children in the Video printer group benefited from segmenting a videotape of an event. Thus, I conclude that the decision-making process of segmentation was the main factor for five-year children's improvement in event memory. But, there was other possible factor contributing to the improvement. All five-year-old children sequenced their own pictures while they made pictures. Several studies reported that young children showed improvement of script memory after they sequenced pictures. Therefore, picture sequencing would be a compounding factor to memory improvement in young children. And recall seemed to have an effect on picture sequencing ability in the children in this study. Several children in this study showed better ability to sequence pictures one day later. This result was unexpected, especially for five-year-old children in the Video Only group, who did not establish a script knowledge of the event. Before they sequenced pictures one day later, they practiced two free recalls of the event. This might be the reason for the improvement of picture sequencing one day later. This issue must also be investigated.

The Significance of the Study

Results of the present study suggest both educational and psychological significance. Developmental theory has recently been reconsidered. It is now known that children are more capable of inference, understanding of number concepts, and understanding causuality than Piaget thought (Gellman & Baillargeon, 1983). Even infants can understand the law sof Phisics (Kellman & Spelke 1983; Spelke, 1990; Spelke, 1992), and the consevation of numbers (Antell & Keating, 1983; Cooper, 1984; Sophian & Adams, 1987). These lines of research owed their theoretical background from nativism. According to nativism, the human mind is innate with specified representational systems (Fodor, 1983). Fodor (1983) stipulated that the human mind is made up of genetically specified "modules" or input systems. Thus, a module guided infant's attention to information matched to the module among incoming informations. For Fodor, there is no development with representational system and environment plays no role in development. He basically thought that neonate had same representational system as adults.

The role of environment on development was explained primarily by Piaget. Behaviorists also regarded environment as an important factor for learning, but they limited their explanations of environment as an associative stimulus for knowledge accumulation. Piaget (1955) argued that knowledge was constructed via assimilation and accomodation of incoming informations. For Piaget, development of human mind is epigenetic in that cognitive development is constructed with a self-organizing system that is directly affected by its interaction with the environment (Karmiloff-Smith, 1992). Even though Piaget's global stage theory has been criticized, his theory of the mechanism of development has been well accepted by educational psycholgists and educators. The results of the present study also show the possible effect of environment on development in children.

In the present study, five-year-old children who only watched an episodic event barely remembered the event even with pictures of the event. Even though there is no research that reports that neonates have script knowledge, three- and four-year-old children were found to have script knowledge: they remembered familiar events in sequence (Hudson & Nelson, 1986; Slackman & Nelson, 1984). From the point of view of nativist, the module of script knowledge would be genetically specified. Thus, even toddlers could be guided by that module to incoming information related to script representation and process those. This may be true, but there remain issues to be resolved even after we agree on possible explanations from the stance of nativists.

Traditionally, developmental difference in memory was attributed to storage capacity and processing ability. But, according to literature of memory development, mnemonic strategies rather than processing ability were found to contribute to developmental differences. Strategy is defined as "cognitive or behavioral activities that are under the deliberate control of a child and are employed so as to enhance memory performance." (Naus & Ornstein, 1983). The use of strategies was found to depend on the context in which children were prompted to use them (Bjorklund & Muir, 1988). When young children were also induced to use the mnemonic strategies, they could benefit in terms of memory (Miller, Seier, Barron, & Probert, 1994; Rao & Moley, 1989). Therefore, children seem to function at their optimal level when the environment is maximally supportive (Fischer, 1980). Five-year-old children who were induced to use organizational strategy in the present study also showed their optimal function in memory: they remembered as much as three times better than five-year-old children who were not induced to use the strategy, and almost as same as seven-year-old children. As I strongly suggest, these results were made by the five-year-old children's own decision making: "self-regulation." In this regard, I hold same line of position as the Piagetians. The five-year-old children in the present study were induced to decide six plan schemes leading a goal by using a video printer. To accomplish, five-year-old children were induced to be active organizers in representation of an event. It is obvious that the task and instruction in the present study played an important role in five-year-old children's improvement of memory when we consider the performance of five-year-old children who just watched passively.

The point of view of nativism in development seems to deserve to be explored as indicated in several researches, but I strongly disagree with the assertion that environment plays no role in the construction of knowledge throughout development.

The present study seems to imply the effectiveness of the application of technology in school. As I suggested in introduction and educational implications, new technology must be accepted whenever it can be applied for educational purposes. I was told that some educators were afraid of using technology for educational purposes because it only cultivated just skill. As indicated in present study, children can be induced to make their own decisions. Some technology might be appropriate for skill training whreas others can be used as scaffolding of learning of content knowledge. The effect of technolgy must be context specific, depending on content of learning..

APPENDIX

PLAN SCHEMES

Plan Scheme 1

Pre-action

Pre-action

Main Action

Main Action

Subsequent Action

Subsequent Action

Plan Scheme 2

Pre-action

Pre-action

Pre-action

Pre-action

Main Action

Main Action

Plan Scheme 3

Main Action

Main Action

Subsequent Action

Plan Scheme 4

Pre-Action

Main Action

Main Action

Main Action

Subsequent Action

Subsequent Action

Plan Scheme 5

Pre-action

Pre-action

Pre-action

Pre-action

Main Action

Subsequent Action

Plan Scheme 6

Pre-action

Pre-action

Pre-action

Main Action

Main Action

Subsequent Action

Plan Scheme 6

Subsequent Action

Subsequent Action

A goal of plans

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